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# RADIO OBSERVATIONS OF ALIGNED QUASAR FIELDS

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## ABSTRACT

Two fields containing peculiar configurations of quasars with large dispersions in redshift have been discussed by Arp and Hazard (1980). These fields were observed at 1400 and at 430 MHz with the Arecibo telescope to search for bridging or extended radio emission that might physically link the quasars. No such emission was found.

## I. INTRODUCTION

Arp and Hazard (1980) have discussed two fields that contain unusual groupings of quasars. In addition to compact groupings there are triplets of quasars which are aligned within the $\approx$2-arcsec resolution of a Schmidt plate. In each triplet, the central quasar has $Z \approx 0.5$ while the outer ones have $Z \approx 2$. Any physical connection between objects which differ in redshift by such a large amount would have profound consequences. For this reason, we used the Arecibo telescope to observe these fields at 430 and at 1400 MHz in order to determine whether or not any bridging radio emission existed between the quasars in each field. After these observations were scheduled, a paper by Edmunds and George (1981) showed that the possibility of chance alignments similar to those found by Arp and Hazard is appreciable. The computer simulations by Edmunds and George concerned only the positional alignments, they did not consider any additional correlations in $Z$. Since the proof of any physical link betewen the quasars would be so important, we decided to proceed with our scheduled observations. Also, both of the fields were considered by Oort, Arp, and de Ruiter (1981) in connection with the possible location of quasars in superclusters, so extended radio emission from the regions would be interesting in this respect as well.

## II. OBSERVATIONS

The observations were made during the period 7–10 December 1981. At 430 MHz the Arecibo telescope has a beamwidth of 9.0 arcmin; at 1400 MHz its beamwidth is 3.3 arcmin. The last set of observations was made at 1400 MHz with a low-sidelobe feed that produces a beamwidth of 3.8 arcmin. At each frequency, drift scans were made at one-half beamwidth intervals in declination. The two fields observed were R.A.: $11^h29^m04^s$ to $11^h31^m46^s$, Dec.: $+10°30'$ to $+11°20'$, and R.A.: $11^h44^m52^s$ to $11^h47^m33^s$, Dec.: $+10°57'$ to $11°31'$. The nearby radio sources, 3C 207, 3C 245, 3C 277.2, and 1318 + 113 were used as flux calibrators and were also used to check the pointing of the system. Only standard corrections were made for the zenith angle dependence of the antenna gain, so flux calibration is accurate to about 15%. Radio maps of each field were made using the ANALYZ programs at the Arecibo Observatory.

Several discrete radio sources were found in the fields. The strongest one in each field was previously known. The positions, fluxes, and spectral indices of the discrete sources are given in Table I. The aligned quasars are typically separated by about 10 arcmin so the 430-MHz beamwidth barely resolves them. The rather crude 430-MHz maps are not reproduced here.

At 1400 MHz the quasars are fairly well resolved. Examples of our 1400-MHz maps are shown in Figs. 1 and 2. In Fig. 1 we have plotted locations of the quasar triplets A, B, C, and X, Y, Z. The designations are those of Arp and Hazard. Quasar A is the known source 1030 + 106 (Veron and Veron 1974). In Fig. 2 we have plotted the location of quasar A and of the quasar tripletts K, B, H, and D, C, J. In this field quasar A is the known source 1146 + 111 (Veron and Veron 1974). No bridging emission was found in either field. Some extended emission may exist near the main source in each field but it is masked by the ring sidelobes of the telescope. These sidelobes have an amplitude of about 10% of the main beam. It could have been useful to apply a beam cleaning routine to these maps in order to eliminate the ring sidelobes, but such an algorithm was not readily available and the project did not warrant its development. The 1130 + 106 field was also mapped employing a low-sidelobe feed that eliminates the ringlobe (at the expense of a larger beamwidth). No bridging or extended emission was detected with this feed.

## III. CONCLUSION

At radio wavelengths we find no evidence for a physical link between the aligned quasars discussed by Arp and Hazard (1980).

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TABLE I. Reliably observed sources.

| R.A. | Dec. | $S_{1400}$ (mJy) | $S_{430}$ (mJy) | $\alpha_{430}^{1400}$ Remarks |
|---|---|---|---|---|
| | | 1130 + 106 field | | |
| $11^h29^m50^s$ | + 11°16′25″ | 92 | 259 | − 0.88 |
| $11^h30^m24^s$ | 10°40′20″ | 853 | 1996 | − 0.72 Source A—Fig. 1 |
| $11^h30^m58^s$ | 11°13′33″ | 47 | 123 | − 0.81 |
| $11^h31^m18^s$ | 10°36′30″ | 109 | 382 | − 1.06 |
| | | 1146 + 111 field | | |
| $11^h46^m14^s$ | 11°08′34″ | 173 | 477 | − 0.86 Source A—Fig. 2 |
| $11^h46^m54^s$ | 11°05′31″ | 91 | Confused | — |

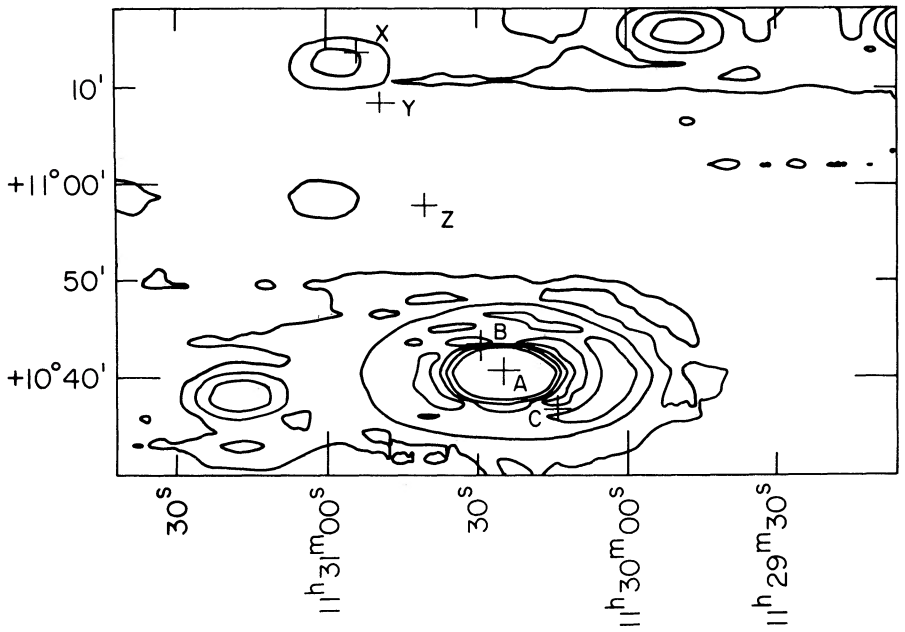


FIG. 1. A contour map of the 1130 + 107 field at 1400 MHz. The aligned quasar triplets are B–A–C and X–Y–Z. Logarithmic contours at 1.5-db intervals are plotted with the high contours deleted on the strong source A.

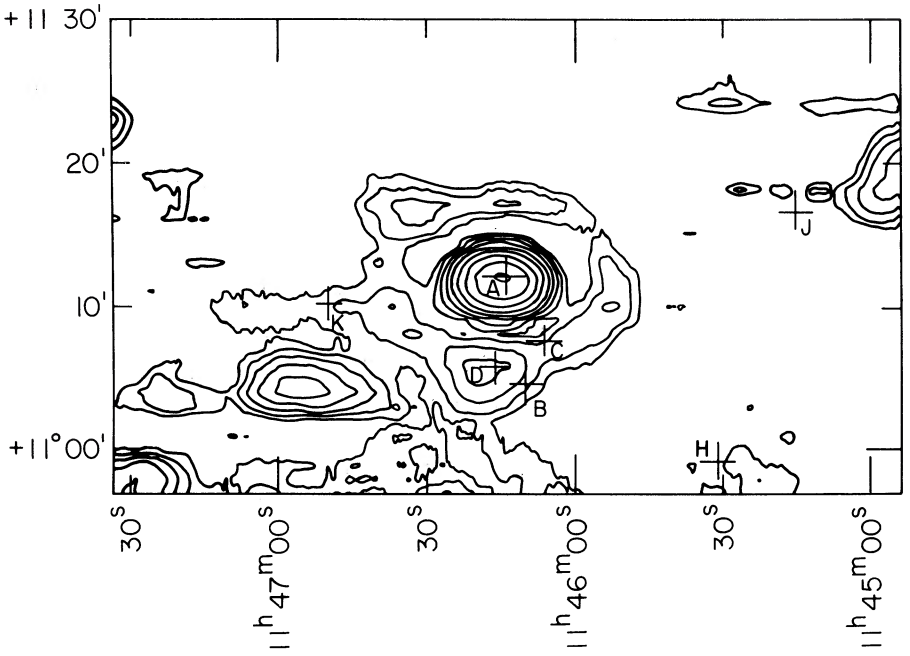


FIG. 2. A map of the 1146 + 111 field at 1400 MHz with a contour interval of 1.5 db. The aligned quasar triplets are K–B–H and D–C–J.

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## REFERENCES

Arp, H., and Hazard, C. (1980). Astrophys. J. **240**, 726.
Edmunds, M. G., and George, G. H. (1981). Nature **290**, 481.
Oort, J. H., Arp, H., and de Ruiter, H. (1981). Astron. Astrophys. **95**, 7.
Veron, M. P., and Veron, P. (1974). Astron. Astrophys. Suppl. **18**, 309.